

**Simmons, Alisha M. (MSFC-NAS802002)[MAINTHIA]**

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**From:** Lewis, William L. (MSFC-NNM05AB50C)[ALLIED]  
**Sent:** Wednesday, September 12, 2007 10:40 AM  
**To:** Simmons, Alisha M. (MSFC-NAS802002)[MAINTHIA]  
**Subject:** Abstract for Verhage AIAA Presentation  
**Importance:** High

Alisha,

Marc Verhage will be giving a briefing at the AIAA Space 2007 Conference in Long Beach, CA, September 18-20.

Here is a brief abstract of his presentation topic, per your request, to accompany the Export Control paperwork I delivered to your office this morning:

**Abstract**

The Upper Stage Element of NASA's Ares I Crew Launch Vehicle (CLV) is a "clean-sheet" approach that is being designed and developed in-house, with Element management at MSFC. The Upper Stage Element concept is a self-supporting cylindrical structure, approximately 84' long and 18' in diameter. While the First Stage Solid Rocket Booster (SRB) design has changed since the CLV inception, the Upper Stage Element design has remained essentially a clean-sheet design approach. A clean-sheet upper stage design does offer many advantages: a design for increased reliability; built-in evolvability to allow for commonality/growth without major redesign; incorporation of state-of-the-art materials and hardware; and incorporation of design, fabrication, and test techniques and processes to facilitate a more operable system.

Please let me know if you have any questions.

Thanks,

Ladd Lewis  
Technical Writer - ESTS Group/Triumph Aerospace  
Ares I Upper Stage Element Office  
256.544.2194

9/12/2007

National Aeronautics and Space Administration



# Ares I Upper Stage Overview

*Marc Verhage  
Ares I Upper Stage  
Chief Engineer  
September 2007*

[www.nasa.gov](http://www.nasa.gov)







# Upper Stage Presentation Objectives

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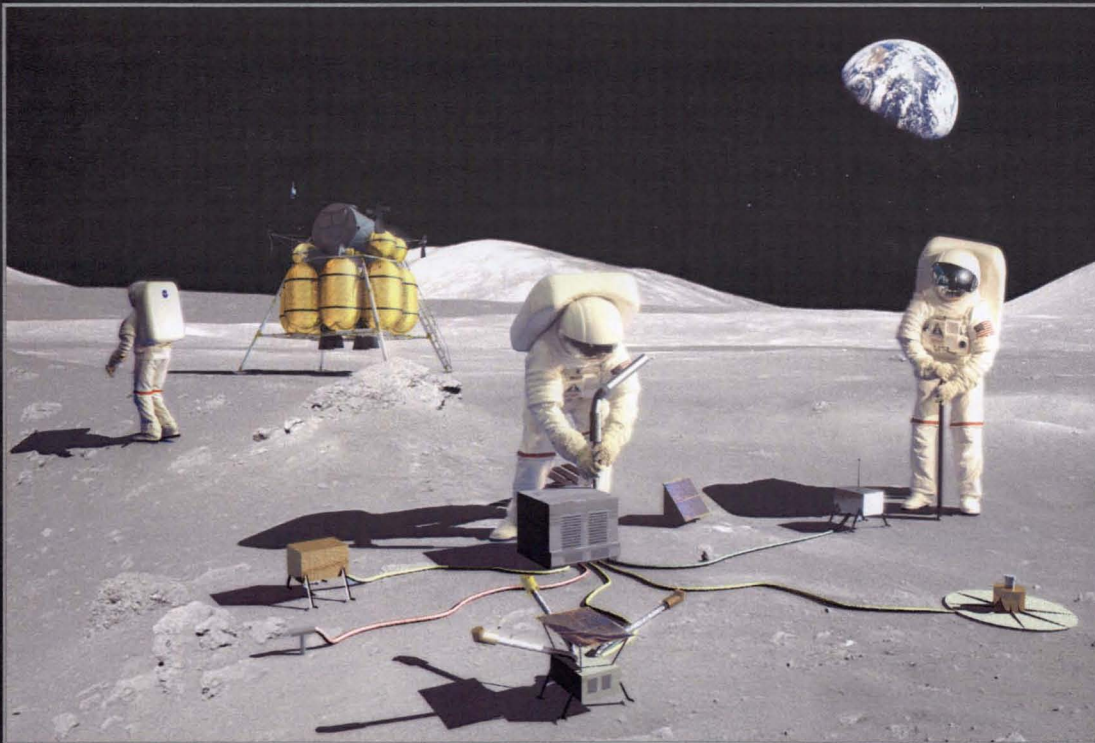


- ◆ The Vision for Space Exploration
- ◆ Role of Upper Stage in Ares I Stack
- ◆ Heritage to Development Comparison
- ◆ Constellation Launch Vehicle Elements
- ◆ Upper Stage Development Approach
- ◆ Ares I Overview and Upper Stage Expanded View
- ◆ Upper Stage Clean-Sheet Design
- ◆ Upper Stage Summary Schedule Roadmap
- ◆ Reference Missions
- ◆ Upper Stage Animated View
- ◆ Upper Stage Production Contract Overview
- ◆ Accomplishments and Path Forward



# The Vision for Space Exploration

- ◆ Complete the International Space Station
- ◆ Safely fly the Space Shuttle until 2010
- ◆ Develop and fly the Crew Exploration Vehicle no later than 2014 (goal of 2012)
- ◆ Return to the Moon no later than 2020
- ◆ Extend human presence across the solar system and beyond
- ◆ Implement a sustained and affordable human and robotic program
- ◆ Develop supporting innovative technologies, knowledge, and infrastructures
- ◆ Promote international and commercial participation in exploration







## Role of Upper Stage in Ares I Stack

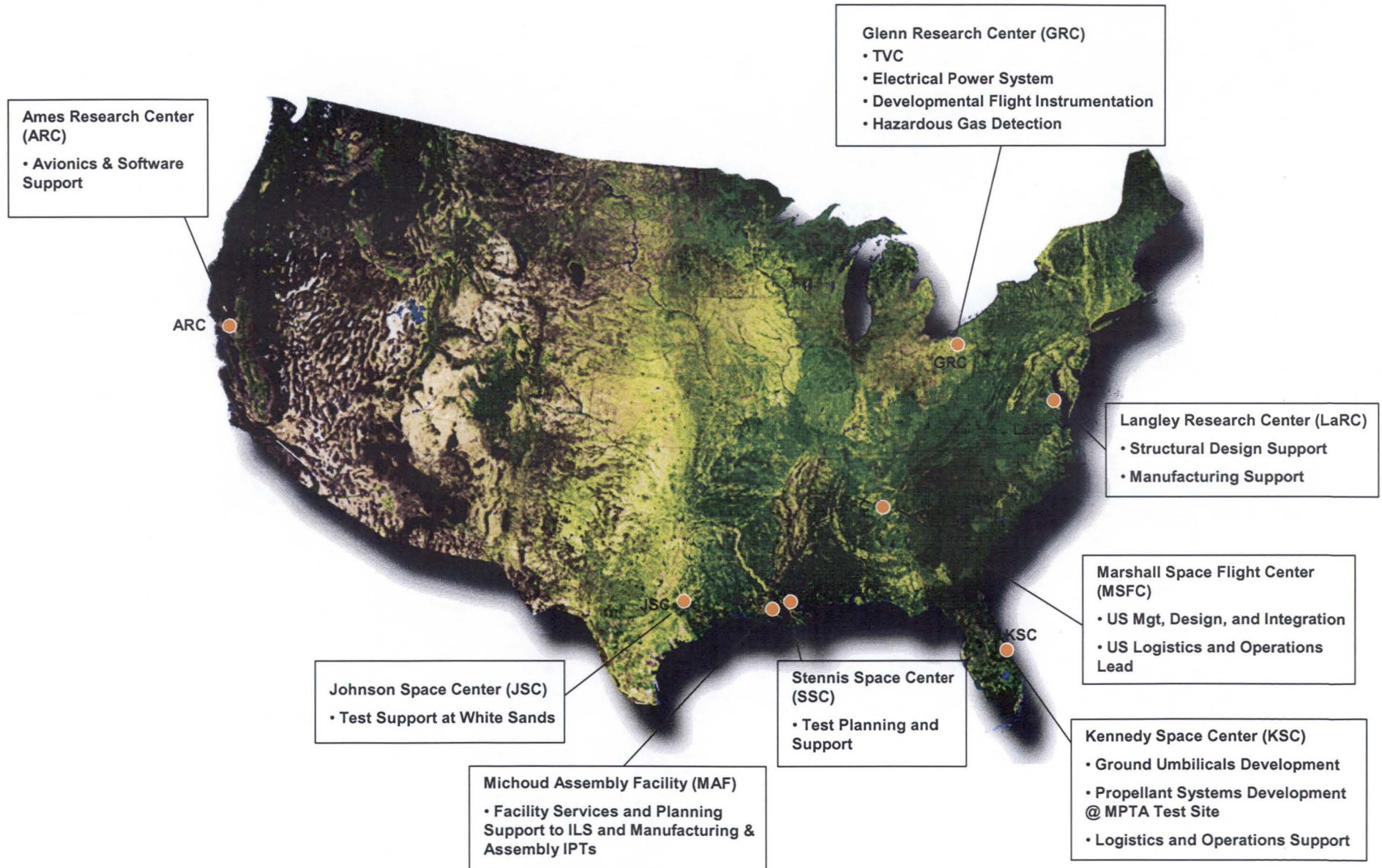
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- ◆ Final integrated Ares I Upper Stage will be the product of numerous partnerships among industry participants, the Production Contractor (Boeing), and NASA Centers.
- ◆ NASA will maintain data rights for the design and resulting Upper Stage hardware.
- ◆ Upper Stage, with J-2X Engine, will provide propulsion, guidance, navigation, and control for second stage of Ares I ascent flight after First Stage separates from the launch vehicle.
- ◆ The Upper Stage Office (USO) is responsible for the US Design, Development, Test, and Evaluation (DDT&E), including project management, development planning, resource planning, tracking, and risk management. The USO is also responsible for the qualification acceptance of flight hardware.
- ◆ The DDT&E period consists of the first five flights of the Ares I (Ares 1-X, Ares 1-Y, Orion 1, Orion 2 - manned, and Orion 3 - manned).



# Ares I Upper Stage Development Approach



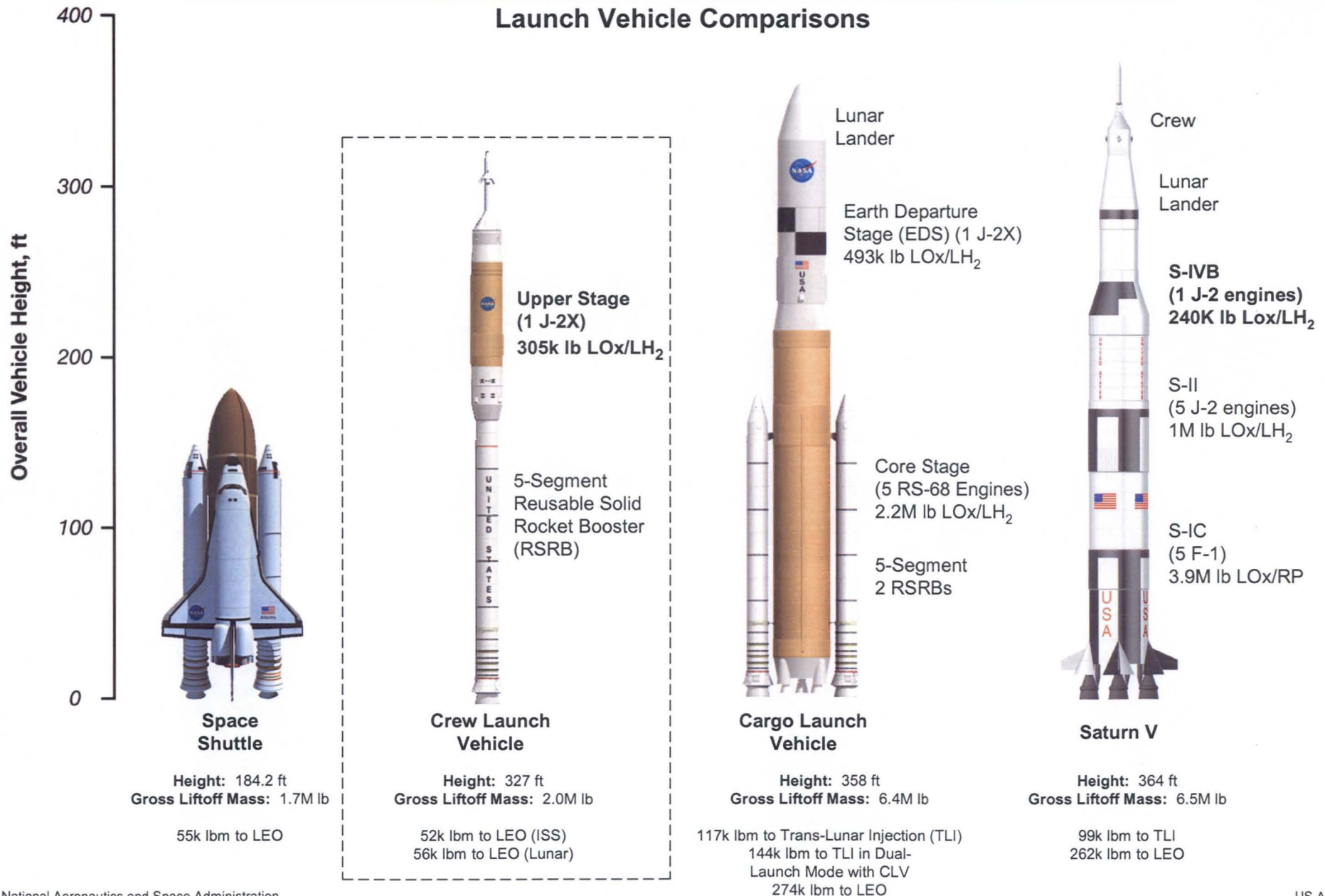




# Heritage to Development Comparison



## Launch Vehicle Comparisons

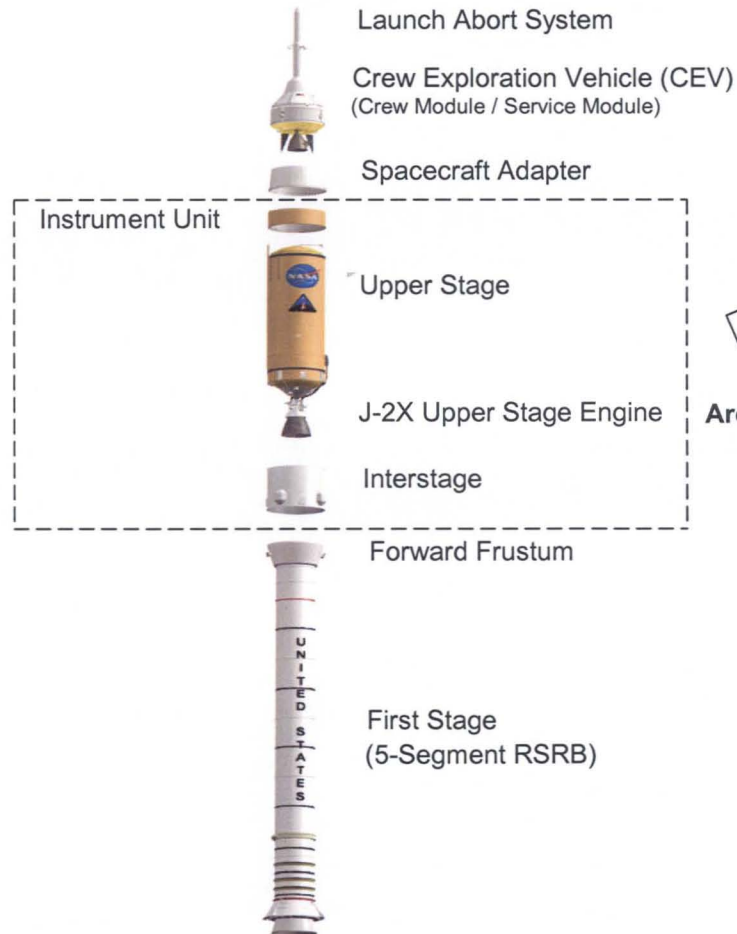




# Constellation Launch Vehicle Elements



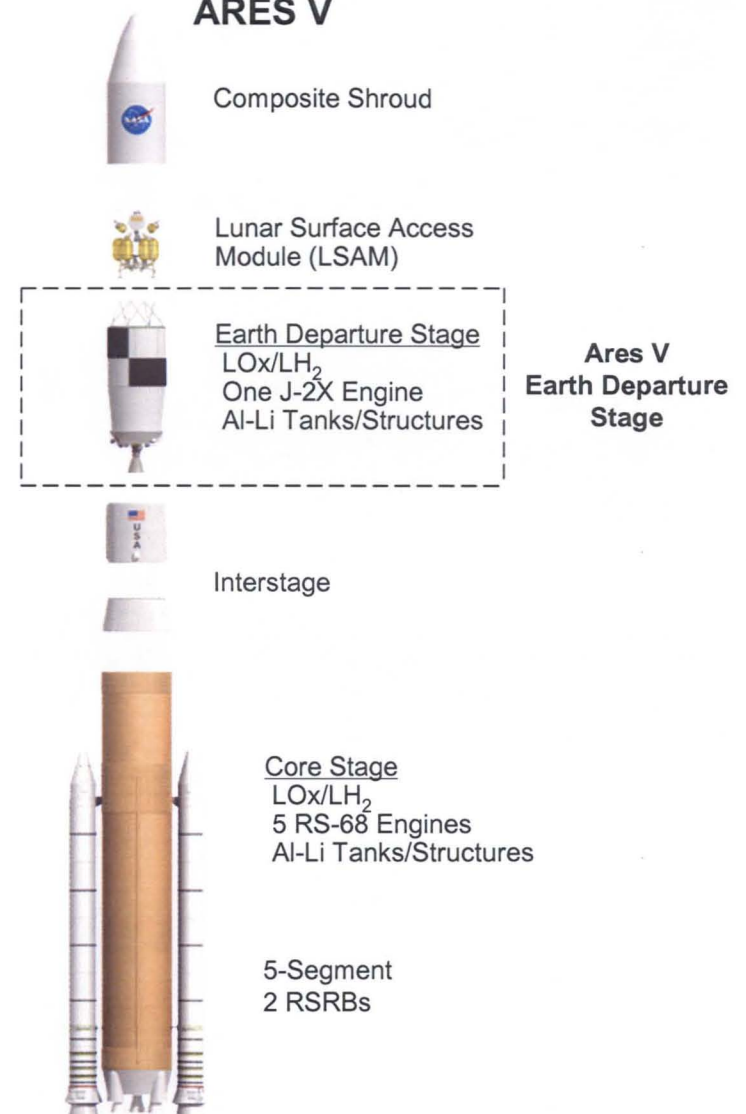
## ARES I



**Crew Launch Vehicle**

**Ares I Upper Stage**

## ARES V



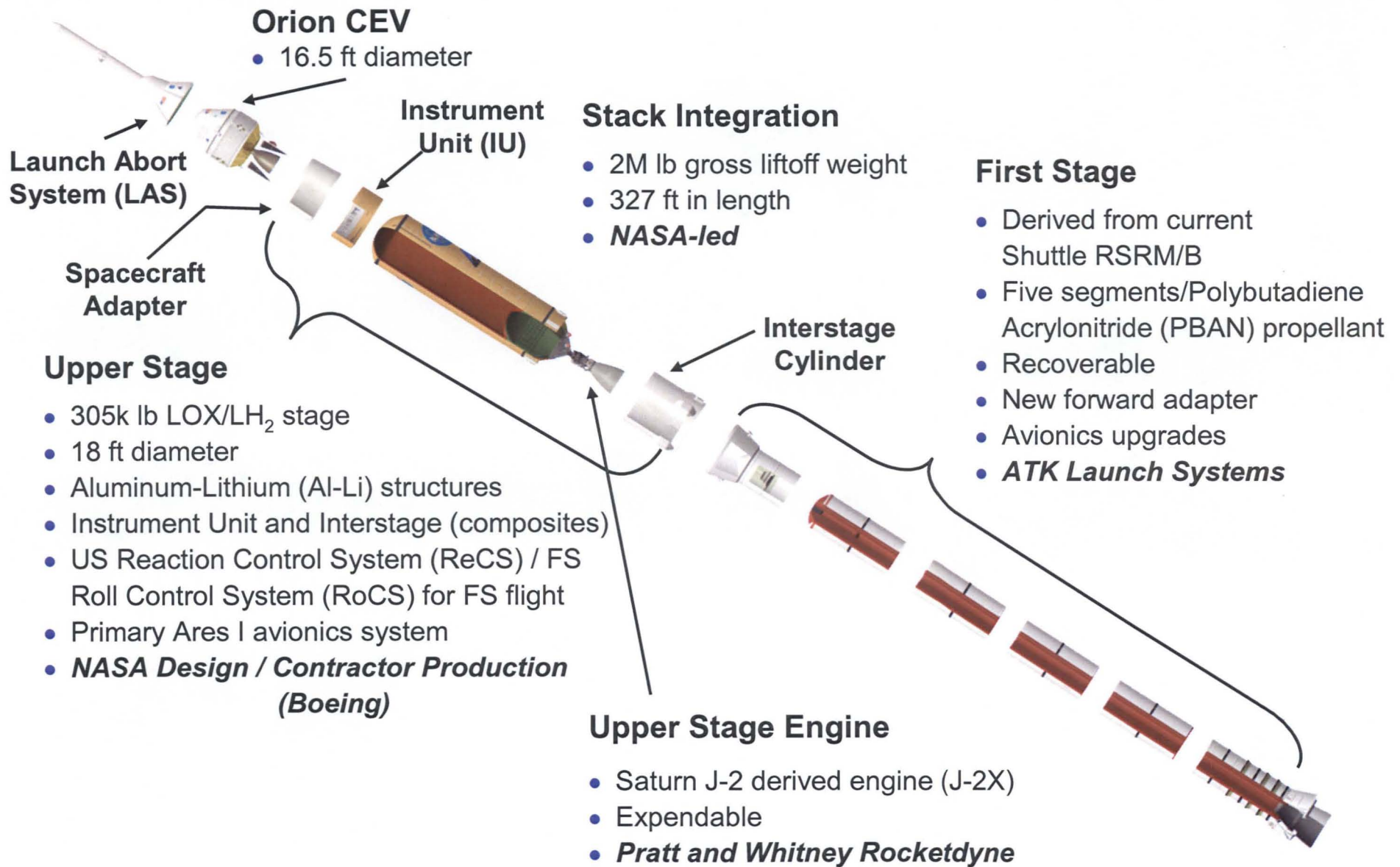
**Cargo Launch Vehicle**

**Ares V  
Earth Departure  
Stage**



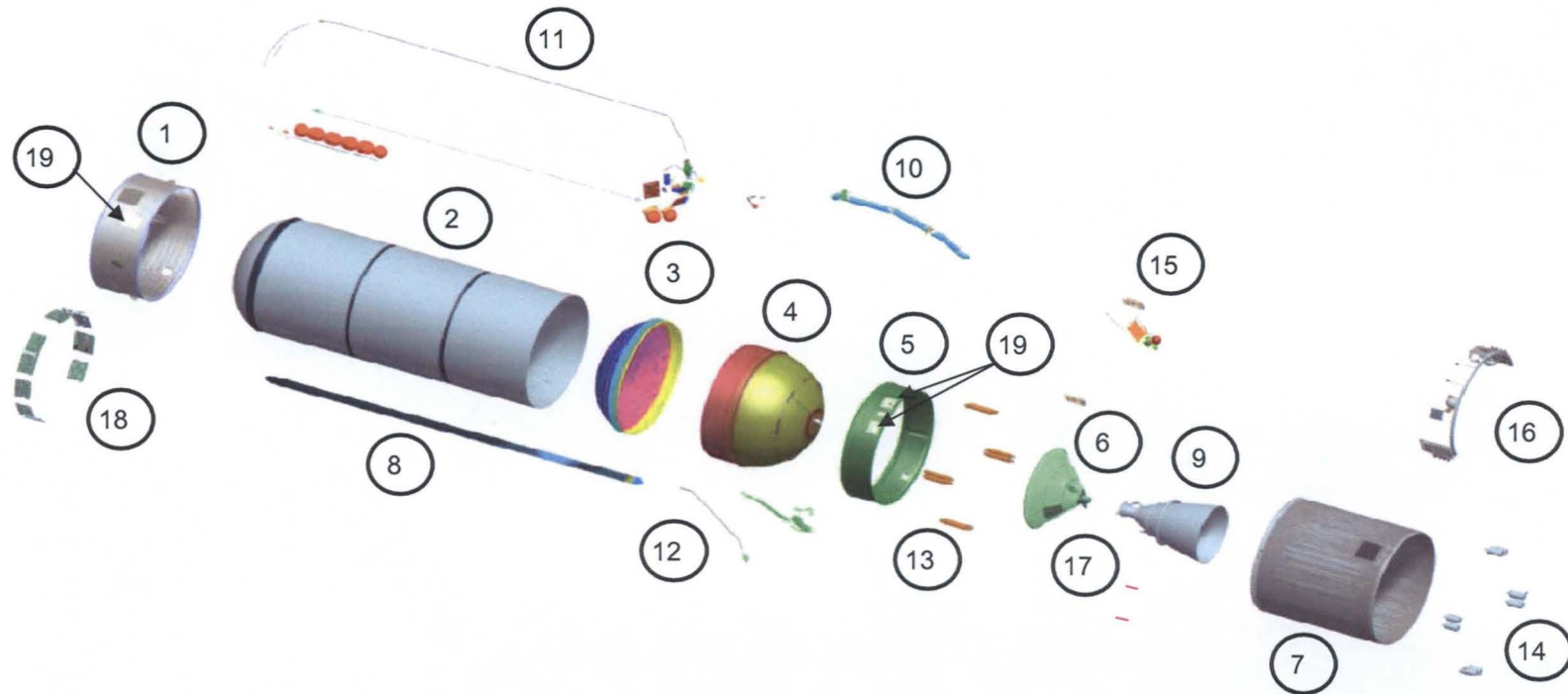


# Ares I Overview





# DAC-2 Upper Stage Expanded View



## LEGEND

1 Instrument Unit	7 Interstage	14 Booster Deceleration Motors
2 Liquid Hydrogen Tank	8 System Tunnel	15 Upper Stage RCS
3 Common Bulkhead	9 Upper Stage Engine	16 First Stage RCS
4 Liquid Oxygen Tank	10 Hydrogen System	17 Thrust Vector Control
5 Aft Skirt	11 Pressurization System	18 Upper Stage Avionics
6 Thrust Cone	12 Oxygen System	19 T-0 Umbilical Panels (3)
	13 Ullage Settling Motors	

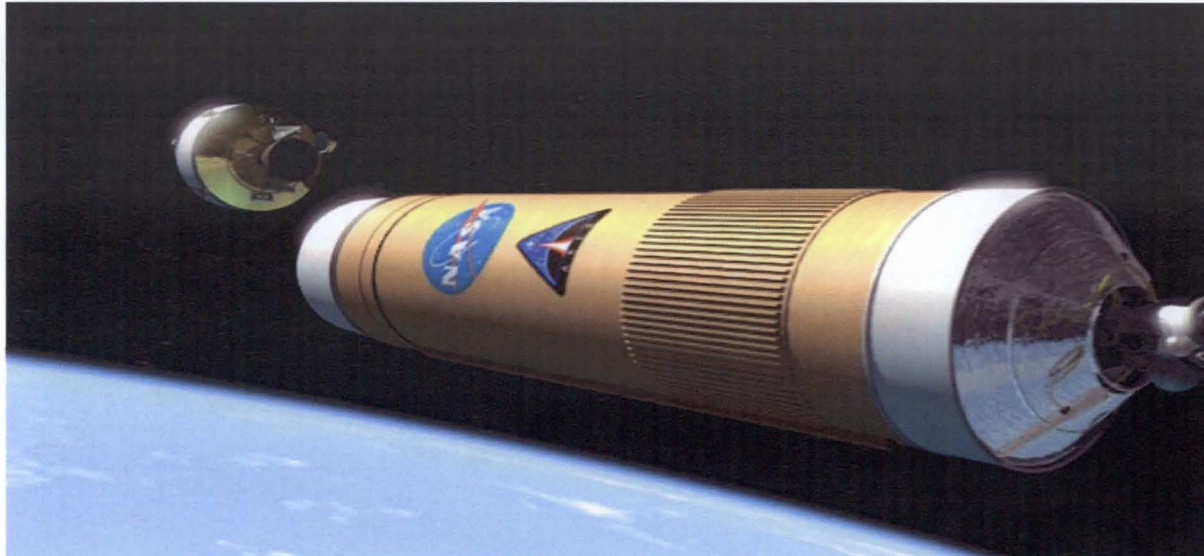




## Upper Stage Clean-Sheet Design



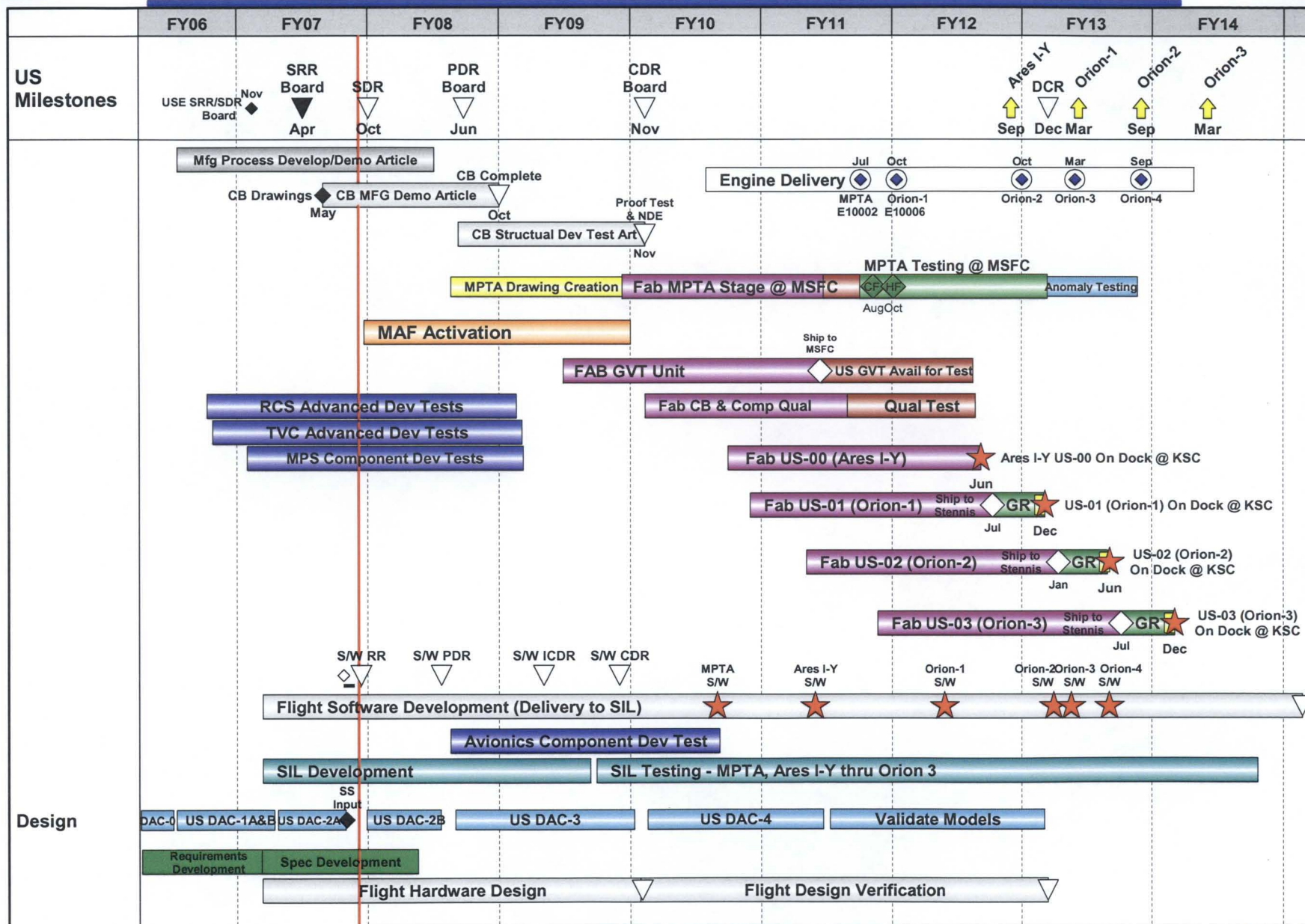
- ◆ Design developed by NASA Design Team (NDT) around the primary requirements for ISS and Lunar missions.
- ◆ Designed for increased supportability (reducing logistics footprint) and increased reliability (to meet human-rating requirements imposed by NASA standards).
- ◆ Design incorporates state-of-the-art materials, hardware, design, manufacturing processes, test techniques, and integrated logistics planning, thus facilitating a supportable, reliable, and operable system.





# US Summary Schedule Roadmap

As of 9/6/07

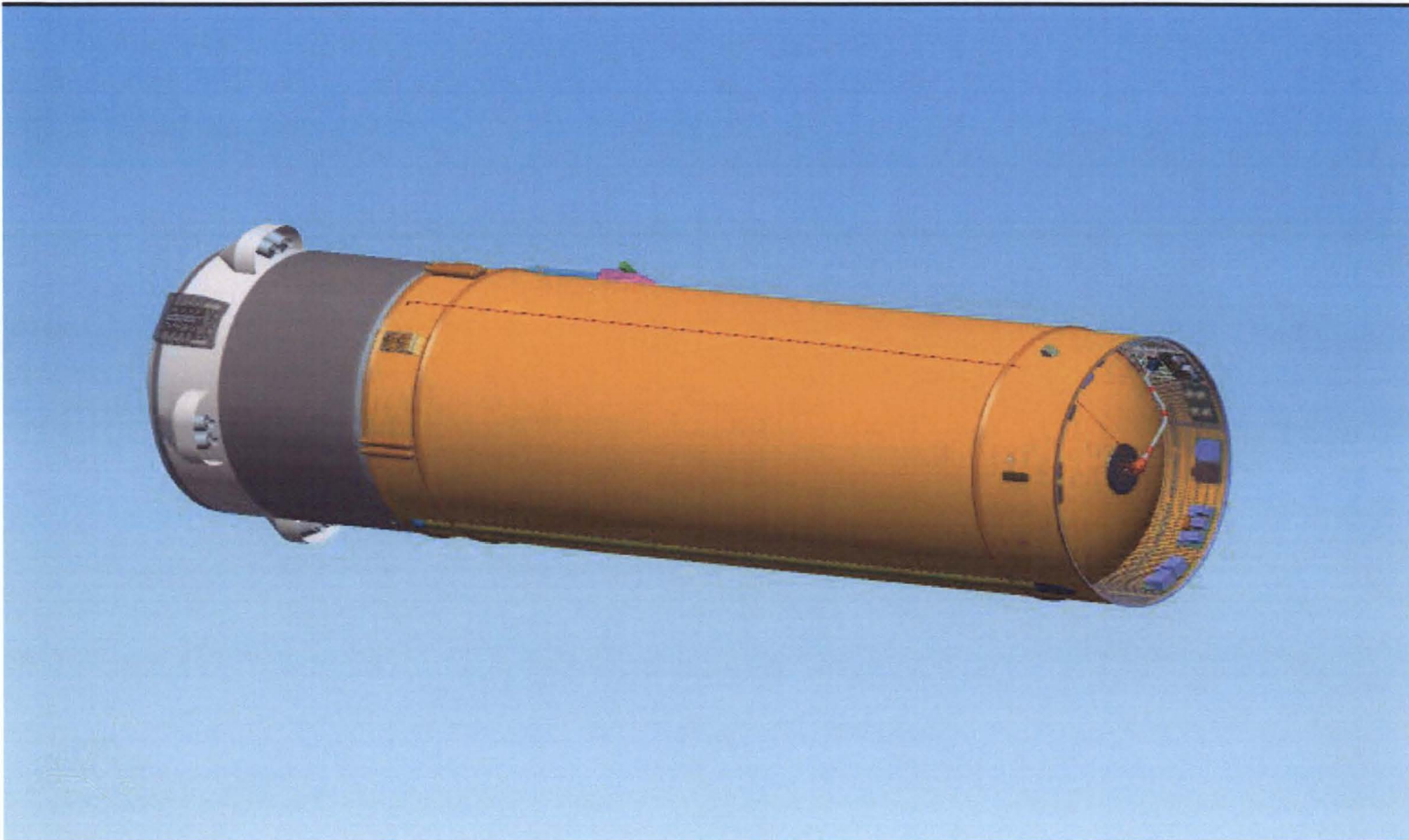






# Ares I Upper Stage Animated View

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# Upper Stage Production (USP) Contract Overview – The Boeing Co.

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## ◆ USP Contract Major Hardware Deliverables

- Ground Vibration Test Article
- Upper Stage Qualification Hardware
- Upper Stage Flight Test Articles
  - Ares I-Y
  - Orion 1
  - Orion 2
- Upper Stage Operational Flight Units
  - **2 Upper Stage Units per contract year (2014-2016)**
- Optional Upper Stage Operational Flight Units
  - **Up to 4 additional Upper Stage Units per contract year (2014-2016)**

## ◆ NASA plans to transition full responsibility for the following at key points during the development and implementation of the Upper Stage project:

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| • Manufacturing and Assembly       | US Preliminary Design Review (PDR)   |
| • Logistics Support Infrastructure | US PDR                               |
| • Configuration Management         | US Critical Design Review (CDR)      |
| • Sustaining Engineering           | US Design Certification Review (DCR) |

## ◆ NASA will assume an insight role for these functions after the completion of an orderly transition at DCR.





# Upper Stage Accomplishments and Path Forward

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- ◆ Completed Upper Stage System Requirements Review (SRR) with team currently working DAC-2 Design.
- ◆ Upper Stage NASA Design Team is established and working to current set of Element Requirements.
- ◆ Upper Stage Production Prime Contractor (Boeing) came on board in September of 2007.
- ◆ Upper Stage Team has completed DAC-2a design in preparation for upcoming System Definition Review (SDR).
- ◆ Upper Stage Avionics Instrumentation Unit (IU) Contract to be awarded in December of 2007.
- ◆ Upper Stage Preliminary Design Review (PDR) slated for June of 2008.
- ◆ First CLV test flight, Ares 1-X, slated for April of 2009.
- ◆ Upper Stage Critical Design Review (CDR) slated for November of 2009.